

Thesis
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Lundy
U. S. Naval Postgraduate School
Annapolis, Md.

GROUP EVALUATION OF THE ACCURACY OF A
SET OF TIME STANDARDS

A Thesis

Submitted to the Faculty

of

Purdue University

by

Joseph Hammond Earnest, Jr.

In Partial Fulfillment of the

Requirements for the Degree

of

Master of Science in Industrial Engineering

June, 1950

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ACKNOWLEDGMENT

The author is very grateful to all who have helped make this work possible, and wishes to express his sincere thanks to:

Dr. Marvin E. Mundel for his valuable guidance and help;

The Motion and Time Study Department Staff for their cooperation and generosity in the use of their equipment;

The Computing Laboratory for their valuable assistance in sorting the data;

My wife for assistance in processing the data;

The Work Session Personnel for their assistance and cooperation.

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ABSTRACT

In the field of time study perhaps the most difficult problem is the rating or relating of the performance to standard. Misunderstandings caused by inconsistent or inaccurate rating of performance can and do cause labor disturbances such as grievances or even strikes.

The problem of this thesis was to evaluate and compare the time study ratings of X Company¹ and the ratings of the other engineers in regard to any differences, if such exist, that might be caused by different concepts, different methods of rating, different geographical areas, different types of companies and types of work with which the time study men are familiar, differences in experience, differences in training, differences in the size of the town or differences in size of the company. Particular attention was given to the consistency of ratings used by X Company as evaluated by the experimental group.

To accomplish these objectives the films furnished by X Company were rated by time study engineers at the Fifth Annual Motion and Time Study Work Session by three methods:

1. A system similar to that used by Company X; viz., judgment of the raters for both a reasonable concept to compare to and a numerical appraisal in reference to this concept.
2. Single-image motion picture as standard or bench mark.
3. Multi-image motion picture with 12 different poses of the same job as a graduated bench mark.

1 X Company is the name assigned to conceal correct name of the concern actually involved.

The data were classified by means of the questionnaire, and International Business Machine Equipment was used to sort and to tabulate the various subgroups.

After the ratings were brought to the same base and allowances were applied where required, comparisons of X Company and work session ratings were made by comparison graphs and least square lines to determine any differences, if such existed. To determine if such results could possibly have occurred by chance alone, or were statistically significant, "t" tests were made upon the above.

The following conclusions were made:

1. In the comparison of the best approximation of 100 by the work session using the judgment technique with X Company's concept of standard, the company averaged 17.3 per cent higher on the six jobs. Statistical "t" tests indicate that this difference is significant at the 5 per cent level. In other words, this difference could occur by chance only one time in twenty. In addition, Elia² found that 33 per cent of the work session engineers rated within ± 5 per cent, 43.4 within ± 7.5 , 58.3 within ± 10 and 84.6 per cent within ± 20 per cent of the overall means to which the X Company ratings were compared above.
2. In the comparison of the best approximation of 100 by the work session using the single-image bench mark with X Company's concept of standard, the company averaged 10.7 per cent higher on

2 Elia, A. J., An Analysis of Current Practice Time Study Ratings, Thesis Purdue University, 1950.

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Business Committee, which was held in New York City on

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the six jobs. In the statistical "t" test, "t" was 0.61 which means that there was probably no statistically significant difference between the two concepts of standard. Sherwood³ found that 33 per cent of the work session engineers rated within ± 5 per cent, 48 per cent within $\pm 7\frac{1}{2}$ per cent, 58 within ± 10 and 89 within ± 20 of the overall means to which the X Company ratings were compared above.

3. There was no appreciable difference in the concepts of standards between the work session, using the Mundel⁴ method of rating and the multi-image bench mark, and the X Company. In the comparison of the best approximation of 100 by the work session and the company, the latter averaged 0.17 per cent lower on the six jobs. However, job number three was 27 per cent higher than the work session mean rating. Greenberger⁵ found that 36 per cent of the work session engineers rated within ± 5 per cent, 47 within $\pm 7\frac{1}{2}$, 62 within ± 10 , and 90 within ± 20 per cent of the overall means to which the X Company ratings were compared above.

3 Sherwood, W. G., An Evaluation of a Single Standard, Single Image Rating Aid for Time Study Rating, Thesis, Purdue University, 1950.

4 Mundel, M. E., Ph. D. Systematic Motion and Time Study, New York, Prentice-Hall Inc., 1947.

5 Greenburger, F. R., An Evaluation of the Mundel Multi-Image Rating Loop, Thesis, Purdue University, 1950.

The first part of the report is devoted to a general survey of the situation in the country.

The second part contains a detailed description of the various regions and their resources.

The third part is devoted to a description of the various industries and their development.

The fourth part contains a description of the various social and economic conditions.

The fifth part is devoted to a description of the various educational institutions and their work.

The sixth part contains a description of the various scientific and literary institutions.

The seventh part is devoted to a description of the various public and private institutions.

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The ninth part is devoted to a description of the various public and private institutions.

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The twenty-seventh part is devoted to a description of the various public and private institutions.

The twenty-eighth part contains a description of the various public and private institutions.

The twenty-ninth part is devoted to a description of the various public and private institutions.

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INTRODUCTION

In the field of time study perhaps the most difficult problem is the rating or relating of the performance to the standard. Misunderstandings caused by inconsistent or inaccurate rating of performance can and do cause labor disturbances such as grievances or even strikes. Gomberg, head of the industrial management department of the International Ladies Garment Workers' Union, states that "all claims by engineers for their pet procedures rest upon an assumed validity of existing time study practices well within the percentage increment or decrement to the wage scale involved in collective bargaining negotiation. Obviously, if after months of negotiations and possible strikes at great financial sacrifice to both sides, a settlement has been reached involving a ten per cent change in the basic rates, neither management nor labor is prepared to sacrifice its respective rights to the blind operations of a technique of questionable accuracy.

"The use of a time study technique to set production standards whose demonstrated inaccuracy may exceed this percentage can become the source of much controversy."¹

There are many methods proposed for rating the performance of a worker. At the Fifth Annual Time Study Work Session, three methods were used. They were judgment, single-image standard film, and multi-image calibrated film. The first, judgment, consisted of the engineers using

1 Gomberg, W., A Trade Union Analysis of Time Study, Science Research Associates, Chicago, 1948, p. 14.

In the first of the three papers the author presents a new method of determining the relative importance of the various factors which enter into the determination of the value of a property. This method is based on the principle that the value of a property is determined by the sum of the values of the various factors which enter into its determination. The author shows how this principle can be applied to the determination of the value of a property in a number of different cases. In the second paper the author discusses the question of the determination of the value of a property in a number of different cases. In the third paper the author discusses the question of the determination of the value of a property in a number of different cases.

The author of the first paper is a well-known expert in the field of property valuation. He has written a number of books on this subject and has been a member of the Royal Society of Arts. The author of the second paper is a well-known expert in the field of property valuation. He has written a number of books on this subject and has been a member of the Royal Society of Arts. The author of the third paper is a well-known expert in the field of property valuation. He has written a number of books on this subject and has been a member of the Royal Society of Arts.

There are many other papers in this volume which deal with the question of property valuation. These papers are written by experts in the field of property valuation and are of great value to anyone interested in this subject. The volume is a valuable addition to the literature of property valuation and is highly recommended to all who are interested in this subject.

I have read the first three papers in this volume and find them to be of great value. The author of the first paper has presented a new method of determining the value of a property which is of great importance. The author of the second paper has discussed the question of the determination of the value of a property in a number of different cases. The author of the third paper has discussed the question of the determination of the value of a property in a number of different cases.

whatever method they normally used. The procedure, however, was, to a large extent, based upon the engineers' experience and ability to estimate the worker's performance and compare it to whatever concept of standard performance the engineers might have.

This method places two tasks upon the engineer. He must develop a mental concept of standard performance and then compare the employee's performance to this standard. Different concepts of standard performance between engineers of a particular company or between companies cause inconsistencies in ratings of the same performance under the same conditions. When the conditions change, the ratings should change. How much? The problem is to evaluate this difference. Here is another place for inaccuracy and inconsistency. From the above we see that the use of "judgment" technique for the time study rating might permit the occurrence of inconsistencies as a result of individual differences. Tiffin² states that in human endeavor individual differences exist as a normal distribution which approximates a bell-shaped curve, with most raters being near average and few being very high or very low.

In an attempt to find a solution for the above problem, Dr. M. E. Mundel³ proposed a technique of rating in which a physical representation of the standard is used; for example, a film of an industrial job. The single-image rating aid consists of a single loop of film of a laboratory job which was used as the standard for rating of the pace

2 Tiffin, J., Ph. D. Industrial Psychology, New York, Prentice-Hall Inc., 1947, p. 17.

3 Mundel, M. E., Ph. D. Systematic Motion and Time Study, New York, Prentice-Hall Inc., 1947, p. 159.

...the

alone of the other jobs at the Work Session. Note, there is a fundamental difference. Under the "judgment" method the entire performance is evaluated against a judged concept, while under the Mundel system, only the pace is rated against an objective standard. Under the latter method, the three factors present are still acknowledged as determining the relative worth of the performance; they are skill, aptitude, and physical exertion. However, Mundel states that skill and aptitude both enter into pace, and physical exertion depends on pace and job difficulty. Only these last two factors are really appraisable. Job difficulty may be reduced to observable measurements which may be obtained from an allowance table leaving only pace to be evaluated.⁴ It is believed that the use of this film as a bench mark, or standard, will increase the accuracy and consistency of the ratings.

In addition, the multi-image film with twelve different paces of the same job was proposed as a graduated bench mark by Mundel for determining the rating of any job in order to eliminate, if possible, the tendency of time study engineers to rate all jobs alike: the slow, too high and the fast, too low.

As will be mentioned in detail in the procedure, X Company uses the "judgment" technique. In order to evaluate the ratings of the X Company, it was proposed to rate the films of their industrial jobs by the three techniques: "judgment", single-image and multi-image films.

⁴ Ibid, p. 163.

OBJECTIVE

The problem is to evaluate and compare the time study ratings of A Company and the ratings of the other engineers in regard to any differences, if such exist, that might be caused by basic inconsistencies, different methods of rating, different geographical areas, different types of companies and types of work with which the time study men are familiar, differences in experience, differences in training, differences in the size of the town, or differences in the size of the company.

The question is to determine the number of ways to choose a subset of size k from a set of size n .

NOTE: you no longer do random walk! It is guided by the gradient

[illegible]

Condition, differences in adjustment, *Environment* is *Psychic*. *Disturbance*

in the case of the first, or otherwise in the case of the second.

PROCEDURE

Motion pictures of the industrial jobs were furnished by A Company. They consisted of films which X Company considered standard for each of the six jobs and other films from which short loops of each of the jobs at a faster and slower pace could be obtained.

The films were:		Name of Job
Job 1	Film 1. slower	evap. liq. inlet hand form 2nd & 3rd bend OPN #12
	2. standard	
	3. faster	
2	4. slower	assembly of thermo body, drive shaft, spring & screws OPN #18
	5. standard	
	6. faster	
3	7. slower	charging valve needle - hand burr hole and rethread OPN #5
	8. standard	
	9. faster	
4	10. slower	check diaphragm travel - thermo diaphragm OPN #11
	11. standard	
	12. faster	
5	13. slower	first bend (600 A cond. outlet conn.) OPN #11
	14. standard	
	15. faster	
6	16. slower	center folding 600 A liner - fold OPN #5
	17. standard	
	18. standard	

Careful analysis was made of the films for the proper allowances of each film and for the proper lengths of each cycle. The following total allowance⁵ was used for each job.

Job	Film	Allowance
1	1, 2, 3	14%
2	4, 5, 6	15%
3	7, 8, 9	12%
4	10, 11, 12	12%
5	13, 14, 15	10%
6	16, 17, 18	17%

⁵ These are the allowances required when the jobs were rated against a single-piece standard. See Mundel, W. E., op. cit., Chap. 13.

There is a heavy loss of water from the soil in the form of vapor. This loss is due to the fact that the soil is not covered by a layer of water or a layer of soil. The loss of water from the soil is due to the fact that the soil is not covered by a layer of water or a layer of soil. The loss of water from the soil is due to the fact that the soil is not covered by a layer of water or a layer of soil.

Year	Area	Population	Area	Population
1950	100	100	100	100
1955	100	100	100	100
1960	100	100	100	100
1965	100	100	100	100
1970	100	100	100	100
1975	100	100	100	100
1980	100	100	100	100
1985	100	100	100	100
1990	100	100	100	100
1995	100	100	100	100
2000	100	100	100	100
2005	100	100	100	100
2010	100	100	100	100
2015	100	100	100	100
2020	100	100	100	100

[illegible]

A detailed description of the system is given in the Appendix.

In determining the allowance, the following factors were considered: personal time, amount of body used, foot pedals, bimanualness, eye and hand coordination, handling requirements, weight handled, and percent of cycle controlled by machine.

The above 18 films were edited and calibrated by Tla and Radkins.⁶

To aid in the classification of the rating data, all the engineers at the work session filled out the questionnaire shown in the Appendix.

The questionnaire was discussed in detail by Borrus.⁷ In order to evaluate X Company ratings the following sub-groups were used:

1. Area
 - Northern Midwest
 - Central Midwest
 - Southern Midwest
 - Michigan
2. Experience
 - 0 - 6 Months
 - 6 Months - 2 Years
 - 2 - 4 Years
 - Over 4 Years
3. Rating Concept
 - Own Concept
 - Film or Other
4. Training
 - College
 - Company
5. Number of Employees
 - Under 200
 - 200 - 1000
 - Over 1000

⁶ Radkins, A. P., Comparison and Evaluation of Three Rating Techniques, Thesis, Purdue University, 1950.

⁷ Borrus, B. G., The Present State of Time Study, Thesis, Purdue University, 1950.

10. *Other comments*

And the *Journalist*, *Alibi* says, goes off to America with its money.

To examine the effect of sleep disturbance, self-rated good/better/worse sleep

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where δ is the distance from the origin to the point (x, y) in the plane.

Please refer to the following URL for more information.

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1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 26

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5. *Conclusions* The present study has shown that the use of a single, low-dose, short-acting benzodiazepine, such as lorazepam, is an effective and safe method for the management of acute alcohol withdrawal. The use of a single, low-dose, short-acting benzodiazepine, such as lorazepam, is an effective and safe method for the management of acute alcohol withdrawal.

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6. Size of Town

Under 5000
 5000 - 10,000
 10,000 - 25,000
 25,000 - 50,000
 50,000 - 100,000
 Over 100,000

A series of 12 films of the same job were calibrated by the engineers. These films were used as the basis for the single and multi-image standards in the latter phases of the work session.⁸ The corrected ratings of the engineers with one year, or more, experience were used to establish these bench marks.

The 18 films of X Company's six jobs of three pages each were then shown to the engineers in random order. They were asked to rate these films by whatever method they were accustomed to use. Their ratings were converted to the base of 150, the numerical designation given to the maximum average pace, and recorded upon IBM cards. The films were shown at 1000 cycles per minute and the speed was maintained constant by means of a stroboscope. No indications whatsoever, of the proper ratings, were given to the group.

Similarly, the 18 films of X Company were shown a second time. The engineers were requested to rate using the Mundel system⁹ with the single-image film, as a standard bench mark of 100 per cent. This aid was the one of the twelve films which they had previously rated as 100 on the base of 150 as the numerical designation given to the maximum

⁸ Lockett, L. S., An Evaluation of Time Study Ratings Made by a Group of Typical Time Study Engineers, Thesis, Purdue University, 1936.

⁹ Mundel, M. E., op. cit.

1. 1000 - 1000
2. 1000 - 1000
3. 1000 - 1000
4. 1000 - 1000
5. 1000 - 1000
6. 1000 - 1000
7. 1000 - 1000
8. 1000 - 1000
9. 1000 - 1000
10. 1000 - 1000

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The first of the two is a copy of the first of the two. The second is a copy of the second of the two. The third is a copy of the third of the two. The fourth is a copy of the fourth of the two. The fifth is a copy of the fifth of the two. The sixth is a copy of the sixth of the two. The seventh is a copy of the seventh of the two. The eighth is a copy of the eighth of the two. The ninth is a copy of the ninth of the two. The tenth is a copy of the tenth of the two.

Similarly, the first of the two is a copy of the first of the two. The second is a copy of the second of the two. The third is a copy of the third of the two. The fourth is a copy of the fourth of the two. The fifth is a copy of the fifth of the two. The sixth is a copy of the sixth of the two. The seventh is a copy of the seventh of the two. The eighth is a copy of the eighth of the two. The ninth is a copy of the ninth of the two. The tenth is a copy of the tenth of the two.

At present, the first of the two is a copy of the first of the two. The second is a copy of the second of the two. The third is a copy of the third of the two. The fourth is a copy of the fourth of the two. The fifth is a copy of the fifth of the two. The sixth is a copy of the sixth of the two. The seventh is a copy of the seventh of the two. The eighth is a copy of the eighth of the two. The ninth is a copy of the ninth of the two. The tenth is a copy of the tenth of the two.

average pace. Later, they were asked to repeat the rating of 15 films using a multi-image film consisting of the 12 pieces that they had previously calibrated. Each was given a calibration chart (see Appendix) to aid in the rating. For details of the above three methods of rating, judgment, single aid, and multi-aid consult the theses of Ela,¹⁰ Sherwood¹¹ and Greenburger.¹² For a comparison of the three methods consult the thesis of Radkins.¹³

10 Ela, A. J., An Analysis of Current Practice Time Study Ratings, Thesis, Purdue University, 1930.

11 Sherwood, W. G., An Evaluation of a Single Standard, Single Image Rating Aid for Time Study Rating, Thesis, Purdue University, 1930.

12 Greenburger, E. M., An Evaluation of the Mundel Multi-Image Rating Loop, Thesis, Purdue University, 1930.

13 Radkins, A. P., op. cit.

usually successful. With the use of a collection net (see Appendix), using a wide-range 1000 collection net (1000 ft. long and 10 ft. wide) is very useful in getting the netting of the lake.

[illegible]

10. The following information is for the year ended 31/12/2019:

[illegible]

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11. *Mathews, J. H., in preparation of a book on the*

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DATA

The data were classified by means of the questionnaire. The following questions and subgroups were used to evaluate the ratings of the work session and to determine the differences, if any existed, between the ratings of the various subgroups and the ratings of X Company:

Question number 4) Area.

1. Northern Midwest except Michigan
2. Central Midwest
3. Southern Midwest
4. Michigan

6) Number of Employees in Plant.

1. Under 200
2. 200 to 1000
3. Over 1000

7) Length of Time You Have Been Taking Time Study.

1. Less than 6 Months actively engaged
2. 6 Months to 2 Years
3. 2 to 4 Years
4. Over 4 Years

8) Where Did You Receive Your Initial Time Study Training?

1. College
2. Company
3. Extension

11) With What Is Your Rating Compared?

1. Your concept of standard performance
2. Some film or other embodiment of standard performance

71) Size of Town in which Plant is Located.

1. Under 5000
2. 5000 - 10,000
3. 10,000 - 25,000
4. 25,000 - 50,000
5. 50,000 - 100,000
6. Over 100,000

International Business Machine equipment was used to sort and to tabulate the results for the above groupings.

and the other two are the same as the first two.

Species	Number of individuals
<i>Thalassidroma</i>	1
<i>Thalassidroma</i>	1
<i>Thalassidroma</i>	1
<i>Thalassidroma</i>	1

1. 1968-1970
2. 1971-1972
3. 1973-1974
4. 1975-1976
5. 1977-1978
6. 1979-1980
7. 1981-1982
8. 1983-1984
9. 1985-1986
10. 1987-1988
11. 1989-1990
12. 1991-1992
13. 1993-1994
14. 1995-1996
15. 1997-1998
16. 1999-2000
17. 2001-2002
18. 2003-2004
19. 2005-2006
20. 2007-2008
21. 2009-2010
22. 2011-2012
23. 2013-2014
24. 2015-2016
25. 2017-2018
26. 2019-2020
27. 2021-2022
28. 2023-2024
29. 2025-2026
30. 2027-2028
31. 2029-2030
32. 2031-2032
33. 2033-2034
34. 2035-2036
35. 2037-2038
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144. 2255-2256
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202. 2371-2372
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1. Low amount of standard performance
2. Low TTR or poor execution of standard
3. High cost of standard

(1) Time at 700 Hz for 100 Hz (100 Hz)

1. 100 Hz - 100 Hz

2. 100 Hz - 100 Hz

3. 100 Hz - 100 Hz

4. 100 Hz - 100 Hz

5. 100 Hz - 100 Hz

6. 100 Hz - 100 Hz

Information furnished to the Department was used in the following manner:

Corrected ratings were obtained from the average ratings by application of the formula $y' = \frac{y \sum xy}{\sum y^2}$. For derivation of this formula see Margolin.¹⁴ The corrected means were determined for all films using all three methods of rating for each of the above subgroups. For details see Ela,¹⁵ Sherwood¹⁶ and Greenburger's theses.¹⁷

In evaluating the ratings assigned by X Company to the three paces of the six industrial jobs, the ratings had to be converted to the same scale as used at the work session. In addition, allowances had to be added to the ratings where the single-image and the multi-image were used to make them comparable. The above was necessary because of differences between the Mundel and X Company definitions and concepts of the standard job and the maximum pace.

Company X states that the standard shall be such that "guaranteed piece work prices shall be set so that a normal employee or group of employees possessing normal skill and training, working under normal conditions, may by normal incentive effort, after making an honest effort to attain incentive earning over a reasonable trial period, have an opportunity to earn per pay period approximately 50% above his piece work base rate or their piece work base rates".¹⁸ Standard is defined by X Company as the time taken when the worker is earning this 50% increment. Dr. Mundel gives as his standard "the amount of time that will be necessary to

¹⁴ Margolin, L., A Comparison of Two Methods of Presentation for Time Study Rating, Thesis, Purdue University, 1950.

¹⁵ Ela, A. J., op. cit.

¹⁶ Sherwood, W. G., op. cit.

¹⁷ Greenburger, F., op. cit.

¹⁸ Contract between Y Union and X Company, 1949.

perform a unit of work, using a given method, under given conditions of work, by a worker possessing sufficient skill to perform the job properly, as physically fit for the job after adjustment to it as the average person who can be expected to be put on the job and working at a pace 100/150 per cent below the maximum pace that can be maintained day after day, without physical effects".¹⁹

These definitions indicate that there will be differences in the numerical value given to standard performance; i. e., a rating of 66.7 per cent with A Company is equal to 100 per cent Mundel except for the effect of Mundel's secondary adjustments. Company A rates the whole job compared to their concept of normal as indicated above. Mundel proposes a two-step rating procedure called objective rating. The steps are:

1. "The rating of observed pace against an objective pace-standard which is the same for all jobs. In this rating no attention whatsoever is paid to job difficulty and its effect on possible pace, hence, a single pace-standard may be used instead of a multiplicity of mental concepts.
2. "The use of a secondary adjustment, consisting of a percentage increment, added after the application of the numerical appraisal from step one has been used to adjust the original observed data. This percentage increment is to be taken from experimentally determined tables of the effect of various observable factors which control the exertion required at a given pace."²⁰ Hence, the true

¹⁹ Mundel, M. E., op. cit.

²⁰ Mundel, M. E., Motion and Time Study Principles and Practice, New York, Prentice-Hall, 1950.

any other day, without special observance. 19

These findings indicate that there is no difference in the amount of value given to different categories of work, a finding which is consistent with a finding by other researchers that the effect of gender is primarily organizational. Finally, it seems that women are more likely to give to personal and domestic work. These findings are consistent with previous studies which indicated that men were more likely to give to organizational work.

1. The effect of increased pressure on the rate of reaction is to increase the rate of reaction. This is because the molecules are forced closer together, increasing the frequency of collisions and the probability of successful collisions. The rate of reaction is therefore increased.

1. The use of a sampling adjustment, consisting of a percentage correction, which after the application of the standard adjustment from that use was made to adjust the original observed data. This percentage adjustment is to be taken from approximately the deviation table in the office of various government bodies which control the statistics compiled at a given time. (2) Hence, the two

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(continued from page 60)

equivalent of 66.7 per cent rating of X Company in practice would be a case wherein the Mundle system rating multiplied by one plus the secondary adjustments given as decimals equaled 100 per cent.

From the above we see that the company's problem and work session item 3 was to rate the whole job including an appraisal of difficulty, while the work session, items 4 and 5²¹, simply rated the pace of the given job and required secondary adjustments for differences in job difficulty from the standard job to make the data comparable. After making the following corrections to the data: (1) conversion of X Company ratings to the base 130 maximum average pace and (2) application of allowances to single-image and multi-image ratings, the ratings of the company were compared to the three work session ratings by means of comparison graphs and least squares lines²² to determine any differences, if such existed, due to area, concept of standard, type of company, method of rating, number of employees and size of town.

To determine if such results could reasonably be ascribed to chance or were statistically significant,²³ 't' tests were made upon the results of the above comparisons.

21 Mundle, M. E., (Editor), Report of Fifth Annual Motion and Time Study Work Session, Purdue University, 1950.

22 Tiffin, J., op. cit.

23 Peters, C. C. and Van Voorhis, W. R., Statistical Procedures and their Mathematical Bases, McGraw-Hill Book Co., Inc., New York, 1940, p. 165.

These authors did not present a theoretical framework. They did not explain why they expected the results that they reported. They did not explain how they expected the results that they reported. They did not explain how they expected the results that they reported.

[illegible]

of the above conditions.

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RESULTS

In the comparison of the best approximation of 100 by work session using the various techniques and X Company's concept of standard, the following results were obtained:

Per Cent X Company Differs From Work Session:

Job Number	Judgment Rating	Single-Image	Multi-Image
1	25%	-14%	-14%
2	20	10	1
3	16	37	27
4	16	10	- 1
5	8	0	- 5
6	21	21	- 9
<hr/>			
Average Differences	17.3%	10.7%	- 0.17%

Note: See p. 3 for job name to identify above job number.

The purpose of the test is to determine the effect of the treatment on the response.

The results of the test are shown in the following table:

Table 1. Results of the test.

The test is a two-way test with two factors.

Top factor	Bottom factor	Response	Mean
1	1	10	10
2	1	20	20
3	1	30	30
4	1	40	40
5	1	50	50
6	1	60	60
7	1	70	70
8	1	80	80
9	1	90	90
10	1	100	100

Table 2. Results of the test.

The test is a two-way test with two factors.

The results of the test are shown in the following table:

Table 3. Results of the test.

The test is a two-way test with two factors.

The results of the test are shown in the following table:

Table 4. Results of the test.

The test is a two-way test with two factors.

The results of the test are shown in the following table:

Table 5. Results of the test.

The test is a two-way test with two factors.

The results of the test are shown in the following table:

Table 6. Results of the test.

The test is a two-way test with two factors.

The results of the test are shown in the following table:

CONCLUSIONS

Factors that might have affected the results of the work session ratings were:

1. Since the engineers rated all day and did not use the multi-image technique until late in the afternoon, fatigue probably affected their ratings.
2. The possible influence of the seating arrangement was not considered.
3. The training curve was not considered. In the use of the new techniques, Greenburger²⁴ mentioned that consistency and accuracy improved with practice when using multi-image aid.
4. The difference in the size of multi-image individual pictures and the job picture may have been a factor. However, Radkins²⁵ stated that there was no significant difference between the three techniques (judgment, single aid and multi-aid) in regard to accuracy and consistency of ratings.

The conclusions drawn from this experiment, within the preceding limitations are:

1. In the comparison of the best approximation of 100 by the work session using the judgment technique and X Company's concept of standard, the company averaged 17.3 per cent higher on the six jobs. Statistical "t" tests indicate that this difference is significant at the 5 per cent level. In other words, this differ-

²⁴ Greenburger, F. R., op. cit.

²⁵ Radkins, A. P., op. cit.

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ence could occur by chance only one time in twenty or less. In addition, Sla²⁶ found that 33 per cent of the work session engineers rated within ± 5 per cent, 45.4 within ± 7.5 , 58.5 within ± 10 and 84.6 per cent within ± 20 per cent of the overall means to which the X Company ratings were compared above.

2. In the comparison of the best approximation of 100 by the work session using the single-image bench mark and X Company's concept of standard, the company averaged 10.7 per cent higher on the six jobs. In the statistical "t" test, "t" was 0.61 which means that there was no statistically reliable difference between the two concepts of standard. Sherwood²⁷ found that 33 per cent of the work session engineers rated within ± 5 per cent, 48 per cent within $\pm 7\frac{1}{2}$ per cent, 58 within ± 10 and 89 within ± 20 of the overall means to which the X Company ratings were compared above.
3. There was no appreciable difference in the concepts of standards between the ratings of the work session, using the Mundel²⁸ method of rating with the multi-image bench mark, and the X Company. In the comparison of the best approximation of 100 by the work session and the company, the latter averaged 0.17 per cent lower on the six jobs. However, job number three was 27 per cent higher than work session mean rating. Greenberger²⁹ found that 36 per cent of the work session engineers rated within ± 5 per cent,

26 Sla, A. J., op. cit.

27 Sherwood, W. A., op. cit.

28 Mundel, W. E., op. cit.

29 Greenberger, F., op. cit.

1. The first part of the paper is devoted to a study of the properties of the function $f(x)$ defined by the equation $f(x) = \sum_{n=0}^{\infty} \frac{x^n}{n!}$. It is shown that $f(x)$ is a continuous function of x and that it satisfies the functional equation $f(x+y) = f(x)f(y)$. The function $f(x)$ is also shown to be the unique solution of this equation which is continuous at $x=0$.

2. In the second part of the paper the author considers the problem of the representation of a continuous function $f(x)$ of a real variable x in the form of a series of the type $\sum_{n=0}^{\infty} a_n \phi_n(x)$, where $\phi_n(x)$ are certain functions which are defined by the equation $\phi_n(x) = \frac{1}{n!} \frac{d^n}{dx^n} f(x)$. It is shown that such a representation is possible if and only if the function $f(x)$ is analytic at $x=0$. The author also considers the problem of the representation of a continuous function $f(x)$ in the form of a series of the type $\sum_{n=0}^{\infty} a_n \psi_n(x)$, where $\psi_n(x)$ are certain functions which are defined by the equation $\psi_n(x) = \frac{1}{n!} \frac{d^n}{dx^n} f(x)$. It is shown that such a representation is possible if and only if the function $f(x)$ is analytic at $x=0$.

47 within $\pm 7\frac{1}{2}$, 62 within ± 10 , and 90 within ± 20 per cent of the overall means to which the X Company ratings were compared above.

In regard to the other parameters under investigation (area, training, number of employees, experience, concept of standard, and size of town) only the following were found to be significantly different from their respective "overall" work session ratings to warrant using for comparison with X Company ratings:

1. In analyzing the judgment technique ratings, Wla³⁰ found only the Michigan group significantly different from the overall ratings. When compared to X Company, the Michigan group using judgment were not significantly different from X Company. The company ratings were 9 per cent higher on the average.
2. In the use of the single-image aid as a bench mark, Sherwood³¹ found Michigan area and the college and company training significantly different from the "overall" work session ratings. However, when compared with X Company ratings the Michigan single-image ratings were not significantly different. The company ratings were 1.7 per cent higher on the average. Also, both the college and the company trained men appeared not statistically significantly different at the one per cent level when compared to the X Company. The X Company differed from them by 16.85 and 15.25 per cent higher, respectively.

³⁰ Wla, A. J., op. cit.

³¹ Sherwood, W. G., op. cit.

at 11:15 a.m. on 10/10/1944. The results of the analysis of the samples are given in the following table.

It is noted that the results of the analysis of the samples are in good agreement with the results of the analysis of the samples of the same type.

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It is noted that the results of the analysis of the samples are in good agreement with the results of the analysis of the samples of the same type.

3. Although Greenburger found that when the work session engineers used the multi-image bench mark, the Michigan area, and the college and company trained men were significantly different from the "overall" ratings, when compared to X Company there was no statistical significance. The company ratings were 1.7, 9 and 6.8 per cent higher respectively than the above subgroups.

Note: It was unfortunate that there was available only one X Company rating for each film and therefore no check on the internal consistency of the ratings of X Company engineers could be made by comparison with the work session ratings.

Although numerous other points from the same section, especially
 near the surface, were used, the results were not
 reliable and many others are not considered significant.
 The 100 (100%) values were used as a basis for the
 statistical adjustment. The average values were 1.7, 7 and
 10 for the three depths of the three sections.

It was determined that there was no difference in the
 results for the 100 and 1000 ft. on the 100 ft. and
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APPENDIX

TABLE 1

OVER ALL

Film No.	K Co. Rating Base 150	Own Concept Wk. Session Rating W.	1+allow. (Multi)	Corrected Single-Image Rating	Single-Image Rating Allow.	Corrected Multi-Image Rating	Multi-Image Rating & Allow.
1	127	104	1.14	98	112	100	114
2	130	105		100	114	102	116
3	151	122		115	131	118	134
4	104	87	1.15	83	94	91	103
5	130	109		105	119	114	129
6	172	144		138	156	150	170
7	116	90	1.12	73	84	81	91
8	130	101		85	95	91	102
9	150	116		97	109	105	118
10	121	104	1.12	97	109	110	123
11	130	112		105	118	118	132
12	167	143		134	150	152	170
13	117	100	1.10	106	117	110	121
14	130	120		117	129	121	133
15	123	114		111	122	115	126
16	138	107	1.19	96	114	109	120
17	143	115		104	124	113	124
18	143	115		104	124	113	124

Note: See p. 5 for names of films to identify above film numbers.

Station No.	Station Name	Station Code	Station Type	Station Category	Station Status	Station Notes
101	101	101	101	101	101	101
102	102	102	102	102	102	102
103	103	103	103	103	103	103
104	104	104	104	104	104	104
105	105	105	105	105	105	105
106	106	106	106	106	106	106
107	107	107	107	107	107	107
108	108	108	108	108	108	108
109	109	109	109	109	109	109
110	110	110	110	110	110	110
111	111	111	111	111	111	111
112	112	112	112	112	112	112
113	113	113	113	113	113	113
114	114	114	114	114	114	114
115	115	115	115	115	115	115
116	116	116	116	116	116	116
117	117	117	117	117	117	117
118	118	118	118	118	118	118
119	119	119	119	119	119	119
120	120	120	120	120	120	120
121	121	121	121	121	121	121
122	122	122	122	122	122	122
123	123	123	123	123	123	123
124	124	124	124	124	124	124
125	125	125	125	125	125	125
126	126	126	126	126	126	126
127	127	127	127	127	127	127
128	128	128	128	128	128	128
129	129	129	129	129	129	129
130	130	130	130	130	130	130
131	131	131	131	131	131	131
132	132	132	132	132	132	132
133	133	133	133	133	133	133
134	134	134	134	134	134	134
135	135	135	135	135	135	135
136	136	136	136	136	136	136
137	137	137	137	137	137	137
138	138	138	138	138	138	138
139	139	139	139	139	139	139
140	140	140	140	140	140	140

Station 101 is the starting point of the survey. Station 140 is the ending point of the survey.

TABLE 2

Area Ratings Using Judgment

Film No.	Group 1	Group 2	Group 3	Group 4
1	101	101	107	114
2	103	102	109	116
3	119	118	126	134
4	84	85	92	95
5	106	106	115	119
6	139	140	152	157
7	88	90	90	93
8	99	101	100	105
9	113	116	115	120
10	105	102	106	111
11	111	110	114	120
12	142	140	146	155
13	111	105	110	111
14	123	116	122	123
15	116	110	116	117
16	108	103	111	115
17	116	111	119	121
18	116	111	119	121

Note: See p. 3 for the names of the films.

Table 1

Frequency of the letters in the alphabet

A	B	C	D	E
1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25
26	27	28	29	30
31	32	33	34	35
36	37	38	39	40
41	42	43	44	45
46	47	48	49	50
51	52	53	54	55
56	57	58	59	60
61	62	63	64	65
66	67	68	69	70
71	72	73	74	75
76	77	78	79	80
81	82	83	84	85
86	87	88	89	90
91	92	93	94	95
96	97	98	99	100

Source: The letters of the alphabet are arranged in alphabetical order.

Table 1 shows the frequency of the letters in the alphabet. The letters are arranged in alphabetical order.

TABLE 3

Area Ratings Plus Allowances Using Single Aid

Film No.	Group 1	Group 2	Group 3	Group 4
1	113	115	112	115
2	109	114	113	116
3	128	132	131	135
4	90	96	99	102
5	114	121	124	130
6	150	159	164	171
7	81	87	91	88
8	91	97	91	100
9	104	112	104	114
10	102	107	112	116
11	110	116	121	125
12	141	153	156	160
13	111	114	114	118
14	123	127	128	130
15	117	121	121	125
16	119	120	118	126
17	124	125	125	131
18	124	125	125	131

Table 1

Table 1. Summary of the data for the 1000 Genomes Project

P. (genotype)	C. (genotype)	S. (genotype)	A. (genotype)	Ref. (genotype)
101	101	101	101	1
102	102	102	102	2
103	103	103	103	3
104	104	104	104	4
105	105	105	105	5
106	106	106	106	6
107	107	107	107	7
108	108	108	108	8
109	109	109	109	9
110	110	110	110	10
111	111	111	111	11
112	112	112	112	12
113	113	113	113	13
114	114	114	114	14
115	115	115	115	15
116	116	116	116	16
117	117	117	117	17
118	118	118	118	18
119	119	119	119	19
120	120	120	120	20

TABLE 4

Area Ratings Plus Allowances Using Multi-Aid

Film No.	Group 1	Group 2	Group 3	Group 4
1	114	116	108	117
2	113	117	111	118
3	133	137	128	138
4	98	104	102	107
5	124	131	128	136
6	164	172	168	179
7	83	94	84	101
8	93	103	94	112
9	110	121	109	129
10	119	123	121	129
11	128	134	130	139
12	164	172	167	177
13	121	124	113	128
14	134	138	123	141
15	128	130	120	134
16	130	127	131	134
17	134	132	136	139
18	134	132	136	139

Table 4

Estimated values of the parameters of the model

Group 1	Group 2	Group 3	Group 4	Group 5
1.1	1.1	1.1	1.1	1.1
1.2	1.2	1.2	1.2	1.2
1.3	1.3	1.3	1.3	1.3
1.4	1.4	1.4	1.4	1.4
1.5	1.5	1.5	1.5	1.5
1.6	1.6	1.6	1.6	1.6
1.7	1.7	1.7	1.7	1.7
1.8	1.8	1.8	1.8	1.8
1.9	1.9	1.9	1.9	1.9
2.0	2.0	2.0	2.0	2.0
2.1	2.1	2.1	2.1	2.1
2.2	2.2	2.2	2.2	2.2
2.3	2.3	2.3	2.3	2.3
2.4	2.4	2.4	2.4	2.4
2.5	2.5	2.5	2.5	2.5
2.6	2.6	2.6	2.6	2.6
2.7	2.7	2.7	2.7	2.7
2.8	2.8	2.8	2.8	2.8
2.9	2.9	2.9	2.9	2.9
3.0	3.0	3.0	3.0	3.0
3.1	3.1	3.1	3.1	3.1
3.2	3.2	3.2	3.2	3.2
3.3	3.3	3.3	3.3	3.3
3.4	3.4	3.4	3.4	3.4
3.5	3.5	3.5	3.5	3.5
3.6	3.6	3.6	3.6	3.6
3.7	3.7	3.7	3.7	3.7
3.8	3.8	3.8	3.8	3.8
3.9	3.9	3.9	3.9	3.9
4.0	4.0	4.0	4.0	4.0

TABLE 5

Training Ratings Using Judgment

Film No.	Group 1	Group 2
1	104	105
2	106	107
3	122	123
4	89	87
5	113	109
6	149	143
7	89	91
8	106	102
9	114	118
10	104	105
11	112	113
12	144	144
13	109	109
14	120	121
15	114	115
16	107	108
17	113	116
18	113	116

TABLE 2

Summary of the data for the 1970-1971 season

Year	1970	1971	1972	1973
1	100	100	100	100
2	100	100	100	100
3	100	100	100	100
4	100	100	100	100
5	100	100	100	100
6	100	100	100	100
7	100	100	100	100
8	100	100	100	100
9	100	100	100	100
10	100	100	100	100
11	100	100	100	100
12	100	100	100	100
13	100	100	100	100
14	100	100	100	100
15	100	100	100	100
16	100	100	100	100
17	100	100	100	100
18	100	100	100	100
19	100	100	100	100
20	100	100	100	100
21	100	100	100	100
22	100	100	100	100
23	100	100	100	100
24	100	100	100	100
25	100	100	100	100
26	100	100	100	100
27	100	100	100	100
28	100	100	100	100
29	100	100	100	100
30	100	100	100	100
31	100	100	100	100
32	100	100	100	100
33	100	100	100	100
34	100	100	100	100
35	100	100	100	100
36	100	100	100	100
37	100	100	100	100
38	100	100	100	100
39	100	100	100	100
40	100	100	100	100
41	100	100	100	100
42	100	100	100	100
43	100	100	100	100
44	100	100	100	100
45	100	100	100	100
46	100	100	100	100
47	100	100	100	100
48	100	100	100	100
49	100	100	100	100
50	100	100	100	100

TABLE 6

Training Ratings Plus Allowances Using Single-Image Film

Film No.	Group 1	Group 2
1	109	115
2	112	114
3	129	132
4	96	95
5	121	120
6	159	158
7	82	85
8	92	96
9	105	111
10	109	109
11	118	116
12	150	149
13	112	116
14	125	128
15	118	121
16	119	120
17	123	125
18	125	125

Table 1

Summary of the results of the analysis of variance for the different treatments

Treatment	Mean	Standard Error	Sum of Squares	D.F.	Mean Square
1	1.00	0.05	0.05	1	0.05
2	1.00	0.05	0.05	1	0.05
3	1.00	0.05	0.05	1	0.05
4	1.00	0.05	0.05	1	0.05
5	1.00	0.05	0.05	1	0.05
6	1.00	0.05	0.05	1	0.05
7	1.00	0.05	0.05	1	0.05
8	1.00	0.05	0.05	1	0.05
9	1.00	0.05	0.05	1	0.05
10	1.00	0.05	0.05	1	0.05
11	1.00	0.05	0.05	1	0.05
12	1.00	0.05	0.05	1	0.05
13	1.00	0.05	0.05	1	0.05
14	1.00	0.05	0.05	1	0.05
15	1.00	0.05	0.05	1	0.05
16	1.00	0.05	0.05	1	0.05
17	1.00	0.05	0.05	1	0.05
18	1.00	0.05	0.05	1	0.05
19	1.00	0.05	0.05	1	0.05
20	1.00	0.05	0.05	1	0.05

TABLE 7

Training Ratings Plus Allowances Using Multi-Image Film

Film No.	Group 1	Group 2
1	113	115
2	115	116
3	132	136
4	104	102
5	130	128
6	171	168
7	84	94
8	94	104
9	109	121
10	121	124
11	131	134
12	167	172
13	121	120
14	135	132
15	127	125
16	129	150
17	133	154
18	133	154

TABLE 8

Number of Employees Ratings Using Judgment

Film No.	Group 1	Group 2	Group 3
1	96	104	102
2	98	106	104
3	113	123	120
4	79	87	87
5	99	110	109
6	130	144	143
7	82	90	89
8	92	101	100
9	106	116	113
10	96	103	103
11	104	113	111
12	133	144	142
13	103	109	107
14	114	120	118
15	108	114	112
16	102	108	106
17	110	116	114
18	110	116	114

Table 1

Arranged in pairs of 1000 samples each

1. Sample	2. Sample	3. Sample	4. Sample	5. Sample
100	101	102	103	104
105	106	107	108	109
110	111	112	113	114
115	116	117	118	119
120	121	122	123	124
125	126	127	128	129
130	131	132	133	134
135	136	137	138	139
140	141	142	143	144
145	146	147	148	149
150	151	152	153	154
155	156	157	158	159
160	161	162	163	164
165	166	167	168	169
170	171	172	173	174
175	176	177	178	179
180	181	182	183	184
185	186	187	188	189
190	191	192	193	194
195	196	197	198	199
200	201	202	203	204
205	206	207	208	209
210	211	212	213	214
215	216	217	218	219
220	221	222	223	224
225	226	227	228	229
230	231	232	233	234
235	236	237	238	239
240	241	242	243	244
245	246	247	248	249
250	251	252	253	254
255	256	257	258	259
260	261	262	263	264
265	266	267	268	269
270	271	272	273	274
275	276	277	278	279
280	281	282	283	284
285	286	287	288	289
290	291	292	293	294
295	296	297	298	299
300	301	302	303	304
305	306	307	308	309
310	311	312	313	314
315	316	317	318	319
320	321	322	323	324
325	326	327	328	329
330	331	332	333	334
335	336	337	338	339
340	341	342	343	344
345	346	347	348	349
350	351	352	353	354
355	356	357	358	359
360	361	362	363	364
365	366	367	368	369
370	371	372	373	374
375	376	377	378	379
380	381	382	383	384
385	386	387	388	389
390	391	392	393	394
395	396	397	398	399
400	401	402	403	404
405	406	407	408	409
410	411	412	413	414
415	416	417	418	419
420	421	422	423	424
425	426	427	428	429
430	431	432	433	434
435	436	437	438	439
440	441	442	443	444
445	446	447	448	449
450	451	452	453	454
455	456	457	458	459
460	461	462	463	464
465	466	467	468	469
470	471	472	473	474
475	476	477	478	479
480	481	482	483	484
485	486	487	488	489
490	491	492	493	494
495	496	497	498	499
500	501	502	503	504
505	506	507	508	509
510	511	512	513	514
515	516	517	518	519
520	521	522	523	524
525	526	527	528	529
530	531	532	533	534
535	536	537	538	539
540	541	542	543	544
545	546	547	548	549
550	551	552	553	554
555	556	557	558	559
560	561	562	563	564
565	566	567	568	569
570	571	572	573	574
575	576	577	578	579
580	581	582	583	584
585	586	587	588	589
590	591	592	593	594
595	596	597	598	599
600	601	602	603	604
605	606	607	608	609
610	611	612	613	614
615	616	617	618	619
620	621	622	623	624
625	626	627	628	629
630	631	632	633	634
635	636	637	638	639
640	641	642	643	644
645	646	647	648	649
650	651	652	653	654
655	656	657	658	659
660	661	662	663	664
665	666	667	668	669
670	671	672	673	674
675	676	677	678	679
680	681	682	683	684
685	686	687	688	689
690	691	692	693	694
695	696	697	698	699
700	701	702	703	704
705	706	707	708	709
710	711	712	713	714
715	716	717	718	719
720	721	722	723	724
725	726	727	728	729
730	731	732	733	734
735	736	737	738	739
740	741	742	743	744
745	746	747	748	749
750	751	752	753	754
755	756	757	758	759
760	761	762	763	764
765	766	767	768	769
770	771	772	773	774
775	776	777	778	779
780	781	782	783	784
785	786	787	788	789
790	791	792	793	794
795	796	797	798	799
800	801	802	803	804
805	806	807	808	809
810	811	812	813	814
815	816	817	818	819
820	821	822	823	824
825	826	827	828	829
830	831	832	833	834
835	836	837	838	839
840	841	842	843	844
845	846	847	848	849
850	851	852	853	854
855	856	857	858	859
860	861	862	863	864
865	866	867	868	869
870	871	872	873	874
875	876	877	878	879
880	881	882	883	884
885	886	887	888	889
890	891	892	893	894
895	896	897	898	899
900	901	902	903	904
905	906	907	908	909
910	911	912	913	914
915	916	917	918	919
920	921	922	923	924
925	926	927	928	929
930	931	932	933	934
935	936	937	938	939
940	941	942	943	944
945	946	947	948	949
950	951	952	953	954
955	956	957	958	959
960	961	962	963	964
965	966	967	968	969
970	971	972	973	974
975	976	977	978	979
980	981	982	983	984
985	986	987	988	989
990	991	992	993	994
995	996	997	998	999
1000	1001	1002	1003	1004

TABLE 9

Number of Employees Ratings Plus Allowances
Using Single-Image Film

Film No.	Group 1	Group 2	Group 3
1	114	113	111
2	115	114	112
3	153	152	150
4	96	90	94
5	121	113	119
6	159	149	156
7	84	80	82
8	94	91	92
9	108	105	105
10	110	104	108
11	119	113	116
12	152	144	149
13	116	113	112
14	128	123	124
15	122	119	118
16	121	122	118
17	126	127	121
18	126	127	121

Table 1

Summary of the results of the analysis of variance

for the different groups

Group	Mean	Standard Error	Significance
1	1.1	0.1	0.1
2	1.2	0.1	0.2
3	1.3	0.1	0.3
4	1.4	0.1	0.4
5	1.5	0.1	0.5
6	1.6	0.1	0.6
7	1.7	0.1	0.7
8	1.8	0.1	0.8
9	1.9	0.1	0.9
10	2.0	0.1	1.0
11	2.1	0.1	1.1
12	2.2	0.1	1.2
13	2.3	0.1	1.3
14	2.4	0.1	1.4
15	2.5	0.1	1.5
16	2.6	0.1	1.6
17	2.7	0.1	1.7
18	2.8	0.1	1.8
19	2.9	0.1	1.9
20	3.0	0.1	2.0

TABLE 10

Number of Employees Ratings Plus Allowances
Using Multi-Aid Film

Film No.	Group 1	Group 2	Group 3
1	107	128	113
2	108	130	114
5	125	139	132
4	104	104	100
5	131	130	125
6	173	172	165
7	86	93	89
8	97	100	101
9	112	120	116
10	123	124	123
11	133	134	133
12	170	171	170
13	122	122	118
14	135	135	130
15	128	129	123
16	128	131	127
17	135	136	132
18	135	136	132

Table 20

Number of employees in the United States, by industry, 1947-1954

(Thousands of persons)

Industry	1947	1948	1949	1950	1951	1952	1953	1954
1. Agriculture, forestry, and fishing	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100
2. Mining and construction	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100
3. Manufacturing	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100
4. Commerce and services	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100
5. Government	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100
6. Education and health	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100
7. Transportation and communication	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100
8. Public utilities	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100
9. Other	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100
10. Total	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100

TABLE 11

Experience Ratings Using Judgment

Film No.	Group 1	Group 2	Group 3	Group 4
1	102	105	104	101
2	104	107	106	105
3	120	125	122	119
4	86	89	87	84
5	108	112	109	106
6	142	146	145	139
7	85	91	90	88
8	95	102	101	99
9	110	117	116	114
10	101	105	104	102
11	109	115	112	110
12	140	145	144	140
13	104	109	107	107
14	117	121	118	117
15	111	115	112	113
16	106	107	107	106
17	114	115	116	114
18	114	115	116	114

Demographic and clinical characteristics

# group	C group	C group	A group	Age (yr)
10	100	100	100	4
10	100	100	100	5
10	100	100	100	6
10	100	100	100	7
10	100	100	100	8
10	100	100	100	9
10	100	100	100	10
10	100	100	100	11
10	100	100	100	12
10	100	100	100	13
10	100	100	100	14
10	100	100	100	15
10	100	100	100	16
10	100	100	100	17
10	100	100	100	18
10	100	100	100	19
10	100	100	100	20
10	100	100	100	21
10	100	100	100	22
10	100	100	100	23
10	100	100	100	24
10	100	100	100	25
10	100	100	100	26
10	100	100	100	27
10	100	100	100	28
10	100	100	100	29
10	100	100	100	30
10	100	100	100	31
10	100	100	100	32
10	100	100	100	33
10	100	100	100	34
10	100	100	100	35
10	100	100	100	36
10	100	100	100	37
10	100	100	100	38
10	100	100	100	39
10	100	100	100	40
10	100	100	100	41
10	100	100	100	42
10	100	100	100	43
10	100	100	100	44
10	100	100	100	45
10	100	100	100	46
10	100	100	100	47
10	100	100	100	48
10	100	100	100	49
10	100	100	100	50
10	100	100	100	51
10	100	100	100	52
10	100	100	100	53
10	100	100	100	54
10	100	100	100	55
10	100	100	100	56
10	100	100	100	57
10	100	100	100	58
10	100	100	100	59
10	100	100	100	60
10	100	100	100	61
10	100	100	100	62
10	100	100	100	63
10	100	100	100	64
10	100	100	100	65
10	100	100	100	66
10	100	100	100	67
10	100	100	100	68
10	100	100	100	69
10	100	100	100	70
10	100	100	100	71
10	100	100	100	72
10	100	100	100	73
10	100	100	100	74
10	100	100	100	75
10	100	100	100	76
10	100	100	100	77
10	100	100	100	78
10	100	100	100	79
10	100	100	100	80
10	100	100	100	81
10	100	100	100	82
10	100	100	100	83
10	100	100	100	84
10	100	100	100	85
10	100	100	100	86
10	100	100	100	87
10	100	100	100	88
10	100	100	100	89
10	100	100	100	90
10	100	100	100	91
10	100	100	100	92
10	100	100	100	93
10	100	100	100	94
10	100	100	100	95
10	100	100	100	96
10	100	100	100	97
10	100	100	100	98
10	100	100	100	99
10	100	100	100	100

TABLE 12
Experience Ratings Plus Allowances Using
Single-Image Film

File No.	Group 1	Group 2	Group 3	Group 4
1	109	112	112	113
2	111	114	123	114
3	126	131	151	152
4	89	95	97	97
5	115	119	122	132
6	149	156	162	160
7	74	87	112	85
8	85	99	97	95
9	96	113	112	108
10	101	109	111	108
11	109	118	120	116
12	139	150	152	149
13	109	122	114	117
14	120	125	128	129
15	114	117	121	125
16	106	120	117	125
17	109	125	121	127
18	109	125	121	127

Approximate average size (mm) of fish

1960-1961 season				
Month	1960	1961	1962	1963
Jan	100	100	100	100
Feb	100	100	100	100
Mar	100	100	100	100
Apr	100	100	100	100
May	100	100	100	100
Jun	100	100	100	100
Jul	100	100	100	100
Aug	100	100	100	100
Sep	100	100	100	100
Oct	100	100	100	100
Nov	100	100	100	100
Dec	100	100	100	100
Jan	100	100	100	100
Feb	100	100	100	100
Mar	100	100	100	100
Apr	100	100	100	100
May	100	100	100	100
Jun	100	100	100	100
Jul	100	100	100	100
Aug	100	100	100	100
Sep	100	100	100	100
Oct	100	100	100	100
Nov	100	100	100	100
Dec	100	100	100	100

TABLE 15
Experience Ratings Plus Allowances
Using Multi-Image Film

Film No.	Group 1	Group 2	Group 3
1	113	113	116
2	116	115	119
3	133	133	137
4	103	102	102
5	123	130	129
6	170	171	170
7	90	94	92
8	101	103	103
9	113	121	118
10	123	127	122
11	132	137	131
12	169	179	168
13	123	119	121
14	136	131	133
15	129	124	127
16	131	130	130
17	137	134	134
18	137	134	134

Approximate weights (in kilograms)

of the following species

Species	Weight (kg)	Species	Weight (kg)
1.11	1.11	1.11	1.11
1.12	1.12	1.12	1.12
1.13	1.13	1.13	1.13
1.14	1.14	1.14	1.14
1.15	1.15	1.15	1.15
1.16	1.16	1.16	1.16
1.17	1.17	1.17	1.17
1.18	1.18	1.18	1.18
1.19	1.19	1.19	1.19
1.20	1.20	1.20	1.20
1.21	1.21	1.21	1.21
1.22	1.22	1.22	1.22
1.23	1.23	1.23	1.23
1.24	1.24	1.24	1.24
1.25	1.25	1.25	1.25
1.26	1.26	1.26	1.26
1.27	1.27	1.27	1.27
1.28	1.28	1.28	1.28
1.29	1.29	1.29	1.29
1.30	1.30	1.30	1.30
1.31	1.31	1.31	1.31
1.32	1.32	1.32	1.32
1.33	1.33	1.33	1.33
1.34	1.34	1.34	1.34
1.35	1.35	1.35	1.35
1.36	1.36	1.36	1.36
1.37	1.37	1.37	1.37
1.38	1.38	1.38	1.38
1.39	1.39	1.39	1.39
1.40	1.40	1.40	1.40

TABLE 14

Concept of Standard Ratings Using Judgment

File No.	Group 1	Group 2
1	103	102
2	105	104
3	122	120
4	86	87
5	100	110
6	143	144
7	89	89
8	100	100
9	115	115
10	103	103
11	112	111
12	143	142
13	108	107
14	119	118
15	113	112
16	107	106
17	113	114
18	113	114

TABLE 15
 Concept of Standard Ratings Plus
 Allowances Using Single-Image Film

Film No.	Group 1	Group 2
1	112	112
2	114	114
3	131	132
4	97	97
5	121	122
6	160	160
7	86	82
8	96	92
9	111	103
10	106	115
11	115	124
12	148	139
13	116	113
14	128	125
15	121	119
16	121	119
17	123	124
18	125	124

LIST OF PLANTS IN THE GARDEN

PLANTS IN THE GARDEN

PLANT	PLANT	PLANT
1. 1. 1.	1. 1. 1.	1. 1. 1.
2. 2. 2.	2. 2. 2.	2. 2. 2.
3. 3. 3.	3. 3. 3.	3. 3. 3.
4. 4. 4.	4. 4. 4.	4. 4. 4.
5. 5. 5.	5. 5. 5.	5. 5. 5.
6. 6. 6.	6. 6. 6.	6. 6. 6.
7. 7. 7.	7. 7. 7.	7. 7. 7.
8. 8. 8.	8. 8. 8.	8. 8. 8.
9. 9. 9.	9. 9. 9.	9. 9. 9.
10. 10. 10.	10. 10. 10.	10. 10. 10.
11. 11. 11.	11. 11. 11.	11. 11. 11.
12. 12. 12.	12. 12. 12.	12. 12. 12.
13. 13. 13.	13. 13. 13.	13. 13. 13.
14. 14. 14.	14. 14. 14.	14. 14. 14.
15. 15. 15.	15. 15. 15.	15. 15. 15.
16. 16. 16.	16. 16. 16.	16. 16. 16.
17. 17. 17.	17. 17. 17.	17. 17. 17.
18. 18. 18.	18. 18. 18.	18. 18. 18.
19. 19. 19.	19. 19. 19.	19. 19. 19.
20. 20. 20.	20. 20. 20.	20. 20. 20.

TABLE 16
 Concept of Standard Ratings Plus
 Allowances Using Multi-Image Film

Film No.	Group 1	Group 2
1	114	116
2	116	117
3	135	136
4	103	93
5	129	128
6	171	168
7	91	94
8	102	103
9	116	121
10	122	123
11	132	136
12	169	172
13	120	121
14	133	134
15	127	128
16	120	129
17	134	134
18	134	134

Table 1

Summary of the results of the analysis

of the data for the period 1970-1979

Year	Value	Year	Value
1970	1.0	1970	1.0
1971	1.1	1971	1.1
1972	1.2	1972	1.2
1973	1.3	1973	1.3
1974	1.4	1974	1.4
1975	1.5	1975	1.5
1976	1.6	1976	1.6
1977	1.7	1977	1.7
1978	1.8	1978	1.8
1979	1.9	1979	1.9
1980	2.0	1980	2.0
1981	2.1	1981	2.1
1982	2.2	1982	2.2
1983	2.3	1983	2.3
1984	2.4	1984	2.4
1985	2.5	1985	2.5
1986	2.6	1986	2.6
1987	2.7	1987	2.7
1988	2.8	1988	2.8
1989	2.9	1989	2.9
1990	3.0	1990	3.0

TABLE 17

Size of Town Ratings Plus Allowances

Using Single-Image Film

Film No.	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
1	119	111	112	114	110	117
2	121	113	114	116	112	119
3	139	130	132	135	130	138
4	103	97	99	103	106	106
5	131	122	124	128	133	133
6	174	161	164	169	176	175
7	95	92	86	87	87	98
8	106	103	99	99	98	110
9	123	135	114	113	112	126
10	120	119	120	121	128	133
11	130	128	130	131	138	143
12	166	163	166	167	177	184
13	121	124	116	117	119	130
14	134	137	129	130	131	143
15	128	130	122	123	124	136
16	132	130	122	128	137	132
17	137	134	127	133	143	137
18	137	134	127	133	143	137

TABLE IV

List of new objects from 1950-1955

1950-1955 (continued)

Object	Object	Object	Object	Object	Object	Object
111	112	113	114	115	116	117
118	119	120	121	122	123	124
125	126	127	128	129	130	131
132	133	134	135	136	137	138
139	140	141	142	143	144	145
146	147	148	149	150	151	152
153	154	155	156	157	158	159
160	161	162	163	164	165	166
167	168	169	170	171	172	173
174	175	176	177	178	179	180
181	182	183	184	185	186	187
188	189	190	191	192	193	194
195	196	197	198	199	200	201
202	203	204	205	206	207	208
209	210	211	212	213	214	215
216	217	218	219	220	221	222
223	224	225	226	227	228	229
230	231	232	233	234	235	236
237	238	239	240	241	242	243
244	245	246	247	248	249	250
251	252	253	254	255	256	257
258	259	260	261	262	263	264
265	266	267	268	269	270	271
272	273	274	275	276	277	278
279	280	281	282	283	284	285
286	287	288	289	290	291	292
293	294	295	296	297	298	299
300	301	302	303	304	305	306
307	308	309	310	311	312	313
314	315	316	317	318	319	320
321	322	323	324	325	326	327
328	329	330	331	332	333	334
335	336	337	338	339	340	341
342	343	344	345	346	347	348
349	350	351	352	353	354	355
356	357	358	359	360	361	362
363	364	365	366	367	368	369
370	371	372	373	374	375	376
377	378	379	380	381	382	383
384	385	386	387	388	389	390
391	392	393	394	395	396	397
398	399	400	401	402	403	404
405	406	407	408	409	410	411
412	413	414	415	416	417	418
419	420	421	422	423	424	425
426	427	428	429	430	431	432
433	434	435	436	437	438	439
440	441	442	443	444	445	446
447	448	449	450	451	452	453
454	455	456	457	458	459	460
461	462	463	464	465	466	467
468	469	470	471	472	473	474
475	476	477	478	479	480	481
482	483	484	485	486	487	488
489	490	491	492	493	494	495
496	497	498	499	500	501	502
503	504	505	506	507	508	509
510	511	512	513	514	515	516
517	518	519	520	521	522	523
524	525	526	527	528	529	530
531	532	533	534	535	536	537
538	539	540	541	542	543	544
545	546	547	548	549	550	551
552	553	554	555	556	557	558
559	560	561	562	563	564	565
566	567	568	569	570	571	572
573	574	575	576	577	578	579
580	581	582	583	584	585	586
587	588	589	590	591	592	593
594	595	596	597	598	599	600
601	602	603	604	605	606	607
608	609	610	611	612	613	614
615	616	617	618	619	620	621
622	623	624	625	626	627	628
629	630	631	632	633	634	635
636	637	638	639	640	641	642
643	644	645	646	647	648	649
650	651	652	653	654	655	656
657	658	659	660	661	662	663
664	665	666	667	668	669	670
671	672	673	674	675	676	677
678	679	680	681	682	683	684
685	686	687	688	689	690	691
692	693	694	695	696	697	698
699	700	701	702	703	704	705
706	707	708	709	710	711	712
713	714	715	716	717	718	719
720	721	722	723	724	725	726
727	728	729	730	731	732	733
734	735	736	737	738	739	740
741	742	743	744	745	746	747
748	749	750	751	752	753	754
755	756	757	758	759	760	761
762	763	764	765	766	767	768
769	770	771	772	773	774	775
776	777	778	779	780	781	782
783	784	785	786	787	788	789
790	791	792	793	794	795	796
797	798	799	800	801	802	803
804	805	806	807	808	809	810
811	812	813	814	815	816	817
818	819	820	821	822	823	824
825	826	827	828	829	830	831
832	833	834	835	836	837	838
839	840	841	842	843	844	845
846	847	848	849	850	851	852
853	854	855	856	857	858	859
860	861	862	863	864	865	866
867	868	869	870	871	872	873
874	875	876	877	878	879	880
881	882	883	884	885	886	887
888	889	890	891	892	893	894
895	896	897	898	899	900	901
902	903	904	905	906	907	908
909	910	911	912	913	914	915
916	917	918	919	920	921	922
923	924	925	926	927	928	929
930	931	932	933	934	935	936
937	938	939	940	941	942	943
944	945	946	947	948	949	950
951	952	953	954	955	956	957
958	959	960	961	962	963	964
965	966	967	968	969	970	971
972	973	974	975	976	977	978
979	980	981	982	983	984	985
986	987	988	989	990	991	992
993	994	995	996	997	998	999
1000	1001	1002	1003	1004	1005	1006
1007	1008	1009	1010	1011	1012	1013
1014	1015	1016	1017	1018	1019	1020
1021	1022	1023	1024	1025	1026	1027
1028	1029	1030	1031	1032	1033	1034
1035	1036	1037	1038	1039	1040	1041
1042	1043	1044	1045	1046	1047	1048
1049	1050	1051	1052	1053	1054	1055
1056	1057	1058	1059	1060	1061	1062
1063	1064	1065	1066	1067	1068	1069
1070	1071	1072	1073	1074	1075	1076
1077	1078	1079	1080	1081	1082	1083
1084	1085	1086	1087	1088	1089	1090
1091	1092	1093	1094	1095	1096	1097
1098	1099	1100	1101	1102	1103	1104
1105	1106	1107	1108	1109	1110	1111
1112	1113	1114	1115	1116	1117	1118
1119	1120	1121	1122	1123	1124	1125
1126	1127	1128	1129	1130	1131	1132
1133	1134	1135	1136	1137	1138	1139
1140	1141	1142	1143	1144	1145	1146
1147	1148	1149	1150	1151	1152	1153
1154	1155	1156	1157	1158	1159	1160
1161	1162	1163	1164	1165	1166	1167
1168	1169	1170	1171	1172	1173	1174
1175	1176	1177	1178	1179	1180	1181
1182	1183	1184	1185	1186	1187	1188
1189	1190	1191	1192	1193	1194	1195
1196	1197	1198	1199	1200	1201	1202
1203	1204	1205	1206	1207	1208	1209
1210	1211	1212	1213	1214	1215	1216
1217	1218	1219	1220	1221	1222	1223
1224	1225	1226	1227	1228	1229	1230
1231	1232	1233	1234	1235	1236	1237
1238	1239	1240	1241	1242	1243	1244
1245	1246	1247	1248	1249	1250	1251
1252	1253	1254	1255	1256	1257	1258
1259	1260	1261	1262	1263	1264	1265
1266	1267	1268	1269	1270	1271	1272
1273	1274	1275	1276	1277	1278	1279
1280	1281	1282	1283	1284	1285	1286
1287	1288	1289	1290	1291	1292	1293
1294	1295	1296	1297	1298	1299	1300
1301	1302	1303	1304	1305	1306	1307
1308	1309	1310	1311	1312	1313	1314
1315	1316	1317	1318	1319	1320	1321
1322	1323	1324	1325	1326	1327	1328
1329	1330	1331	1332	1333	1334	1335
1336	1337	1338	1339	1340	1341	1342
1343	1344	1345	1346	1347	1348	1349
1350	1351	1352	1353	1354	1355	1356
1357	1358	1359	1360	1361	1362	1363
1364	1365	1366	1367	1368	1369	1370
1371	1372	1373	1374	1375	1376	1377
1378	1379	1380	1381	1382	1383	1384
1385	1386	1387	1388	1389	1390	1391
1392	1393	1394	1395	1396	1397	1398
1399	1400	1401	1402	1403	1404	1405
1406	1407	1408	1409	1410	1411	1412
1413	1414	1415	1416	1417	1418	1419
1420	1421	1422	1423	1424	1425	1426
1427	1428	1429	1430	1431	1432	1433
1						

TABLE 18

Size of Town Ratings Plus Allowances

Using Multi-Image Film

Film No.	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
1	103	105	103	104	112	98
2	105	107	104	105	113	100
3	121	124	121	122	131	115
4	85	91	85	87	95	84
5	107	114	107	109	119	105
6	141	150	140	144	157	138
7	88	91	91	88	91	89
8	98	102	102	99	102	100
9	113	117	117	114	117	115
10	103	107	100	104	109	105
11	111	115	108	112	117	111
12	142	147	138	144	150	142
13	107	116	109	108	113	102
14	119	128	119	119	125	112
15	113	122	113	113	119	107
16	106	112	107	106	114	101
17	114	121	115	114	122	109
18	114	121	115	114	122	109

Figure 1

X Company Ratings

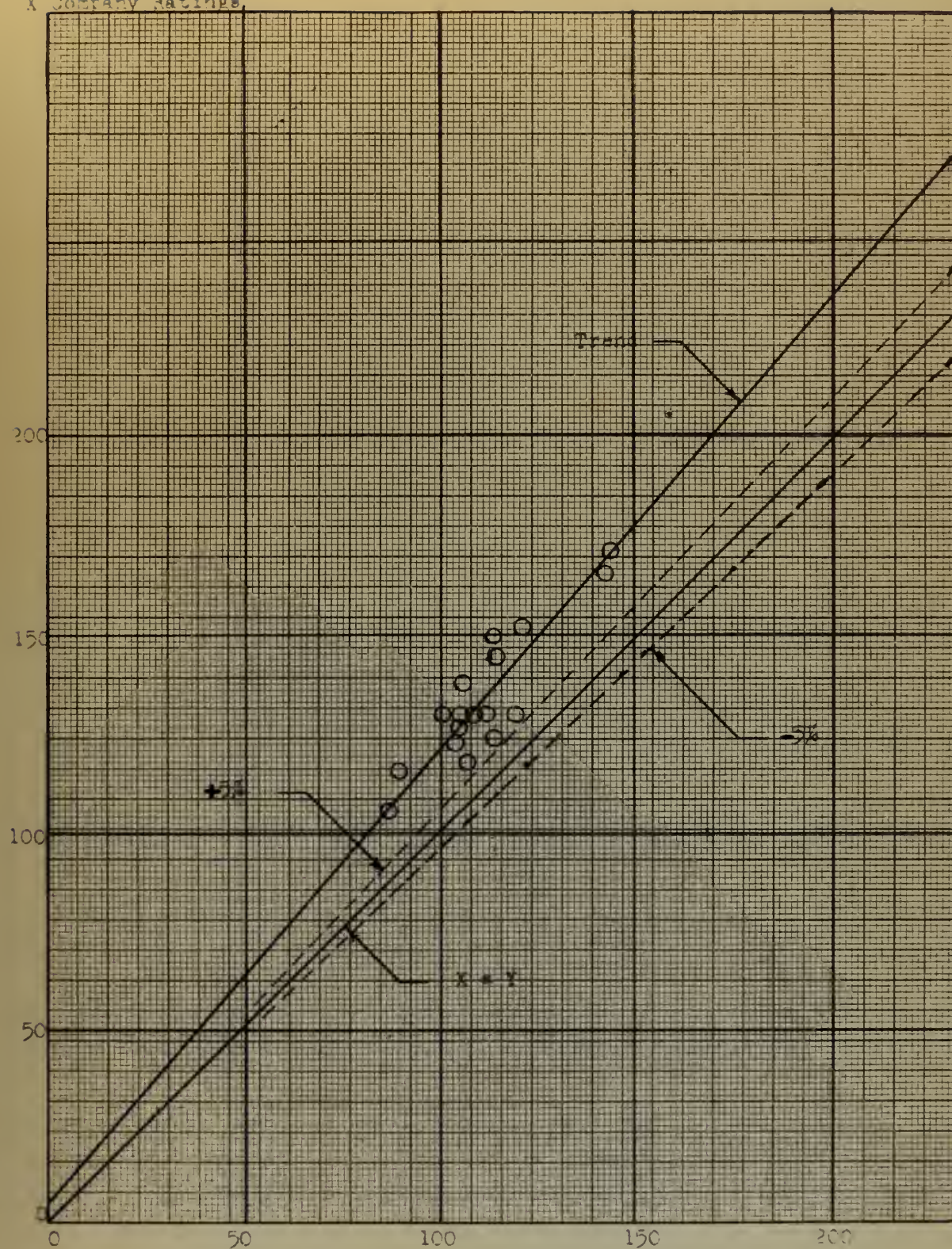
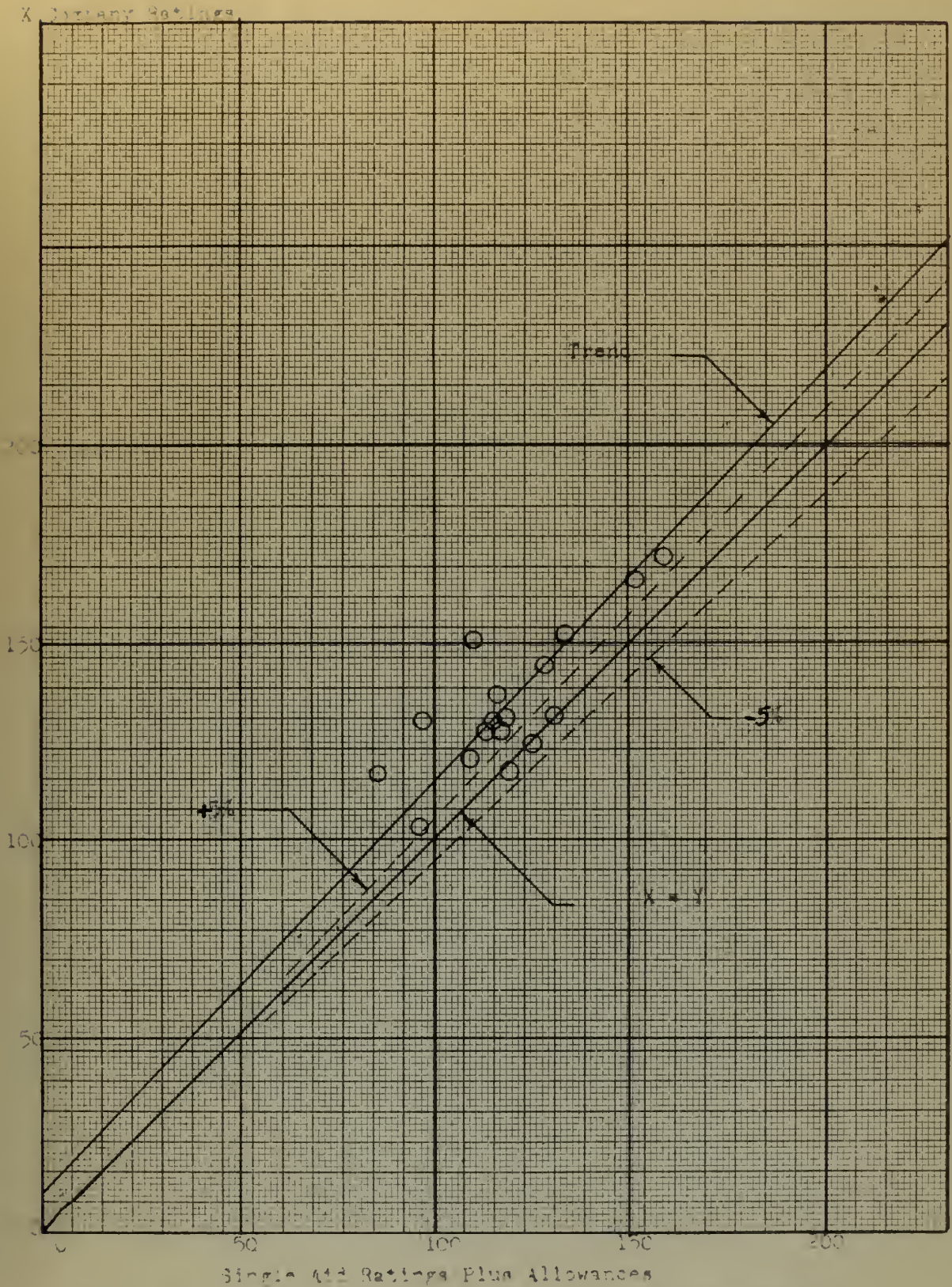


Figure 2



Single Aid Ratings Plus Allowances Versus X January Ratings

Figure 3

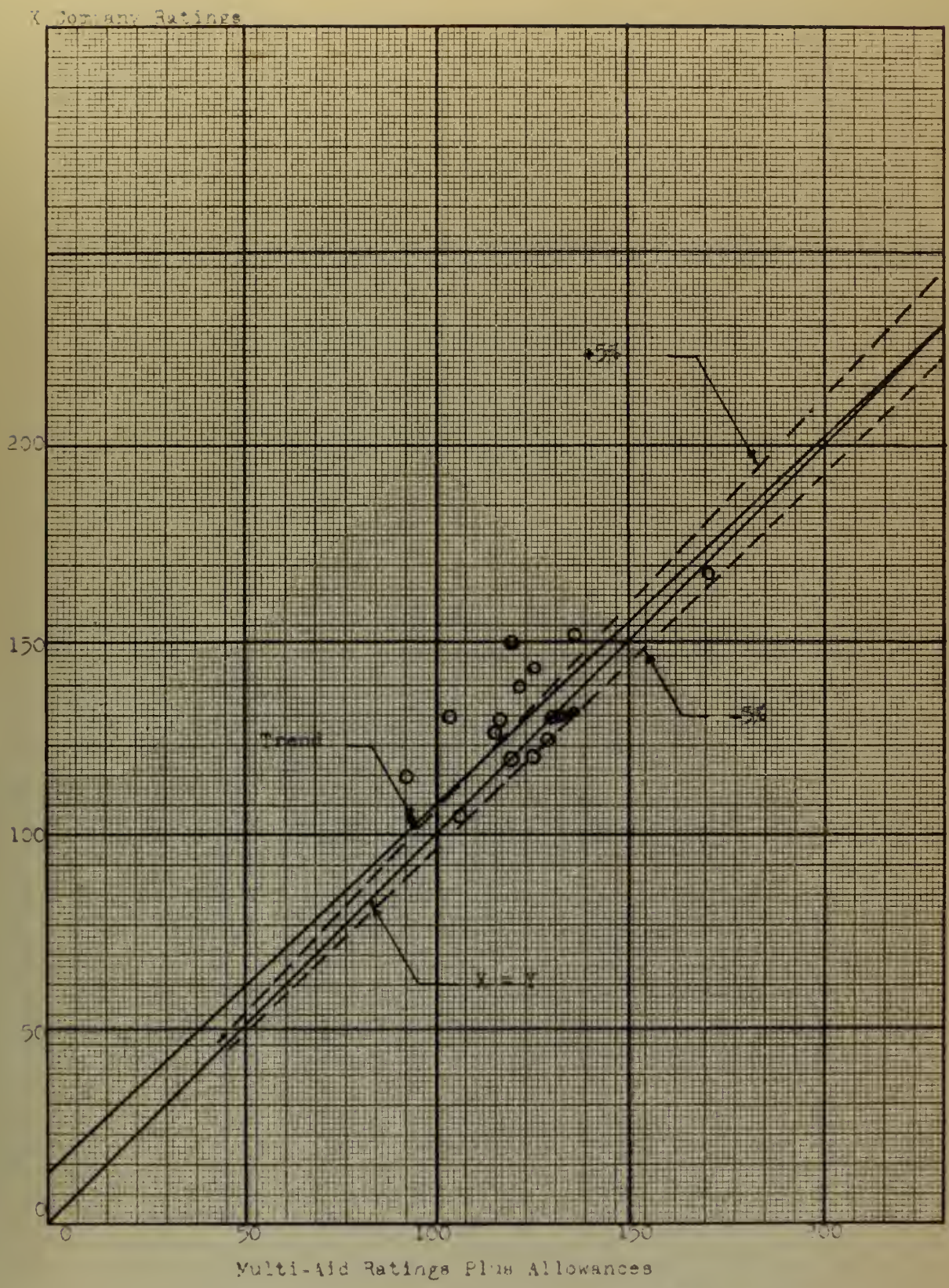


FIGURE 4
TIME STUDY WORK SESSION QUESTIONNAIRE

BSB-TSQ #1-FD

BE SURE TO COPY THE FIRST THREE DIGITS OF YOUR CARD DECK NUMBER IN THE SPACE PROVIDED. Please answer all questions as accurately as possible. Circle number to left of appropriate answer. All of the information on this questionnaire is considered CONFIDENTIAL. Neither your name nor the company name will be revealed in any way.

1.	2.	3.

A. Name _____

B. Company _____

4. Mailing Address _____

5. What characterizes the direct labor in your plant:

1. Bench work
2. Machine work
3. Gross body movements (moving around)
4. Equal amounts of all three named above.

6. Number of employees in your plant.

1. 50 or less
2. 51 to 100
3. 101 to 200
4. 201 to 300
5. 301 to 500
6. 501 to 750
7. 751 to 1000
8. 1001 to 1500
9. Over 1500

7. Length of time you have been making time studies.

1. Less than six months and actively engaged
2. Less than six months, but not now actively engaged
3. More than six months, but less than a year and actively engaged
4. More than six months, but less than a year and not now actively engaged
5. More than one year, but less than two years and actively engaged
6. More than one year, but less than two years and now now actively engaged
7. Two to four years
8. Five to ten years
9. Over ten years

8. Where did you receive your initial time study training? Give name and location.

1. College _____
2. Extension _____
3. Company _____
4. Other _____

For Office
Use
(9) (10)

11. Do you rate compared to

1. your concept of standard performance
2. some film or other embodiment of standard performance

12. Do you rate

1. pace
2. rate of activity
3. speed of movement
4. skill and effort
5. effort
6. skill, effort, conditions, and consistency (Westinghouse)
7. effective speed
8. attitude plus other factors
9. Other _____

13. Which method do you use for your ratings?

1. a point basis
2. a percentage basis

14. Do you use wage incentives?

1. Yes
2. No

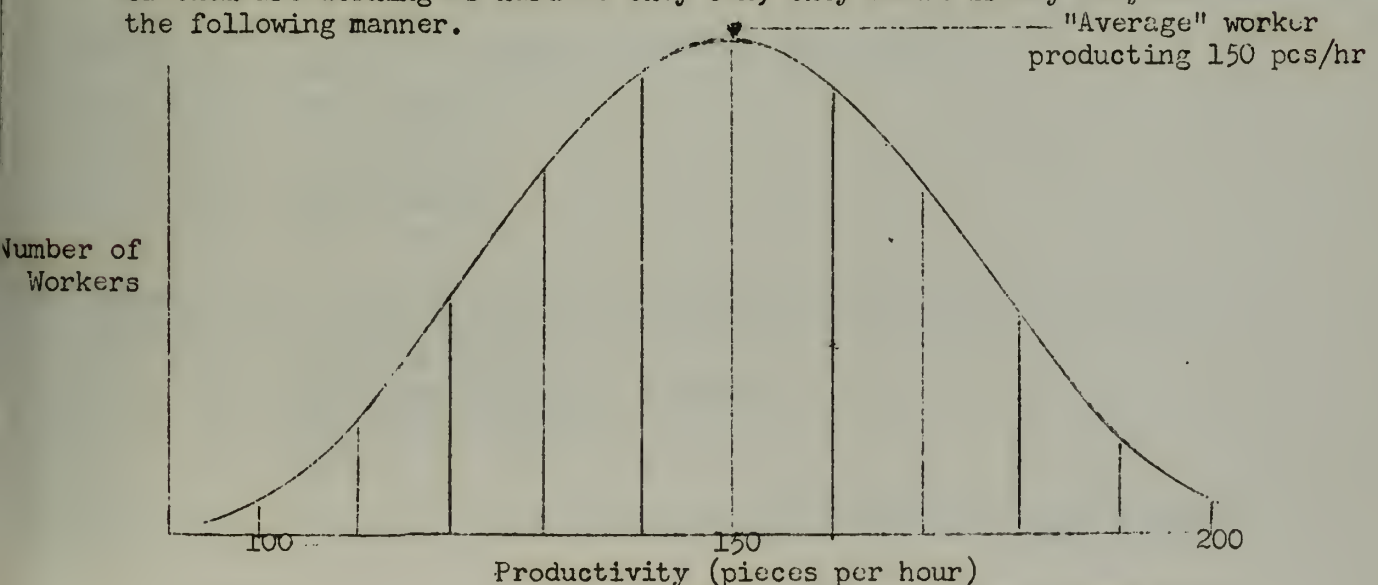
15. Do you apply an incentive allowance to final computed time study results?

1. Yes, how much _____
2. No.

17. What is the percent increment or ratio by which the typical employee can exceed the standard? _____

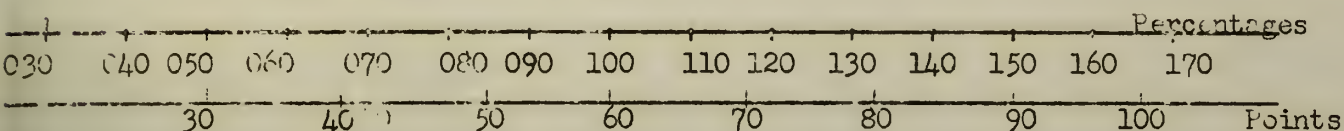
18. Please define the Standard performance which you use as a basis for your ratings in terms of "who", "doing what", and "Working how".

19. Assuming you have a large number of workers on one job, and that all of them are working as hard as they can, they would likely vary in the following manner.



(Question 19 continued on next page)

19. (Con't) Please indicate on the following scale the rating value you would assign if you observed the "average" worker working as hard as he could and producing 150 pieces per hour. Mark the appropriate scale at the appropriate place.



22. When studying a job, do you require a performance within a certain range?
(Such as requiring a performance between 80% and 120% before the study is made).
If so, please state limits.

Use one set of appropriate blanks.

_____ to _____ percentages
to points

- 23 Do you have a union in your plant?

1. yes
2. no

24. Do you have union participation in your time studies?

1. yes
2. no

25. What is your position in the organization of the plant?

1. Head of Industrial Engineering Dept.
2. Member of staff of Indust. Eng. Dept.
3. Head of Time Study Dept.
4. Member of staff of Time study dept.
5. Head of Production Department
6. Member of Staff of Production Dept.
7. Head of Control Dept.
8. Member of staff of Control Dept.
9. Other

26. Do you have an engineering degree?

1. Yes
2. No

27. About how long has your plant been making time studies?

1. Less than a year
2. 1 to 3 years
3. 4 to 6 years
4. 7 to 10 years
5. Over 10 years
6. I don't know.

28. Which of the following methods of recording time studies do you make the most use of in your plant?

1. Continuous timing
2. Repetitive (snap-back) timing
3. Accumulative timing
4. Camera

29. About what percentage of the employees in your plant are union members?

%

30. If your union contract contains sections pertaining to time study work, which of the following may be found in your contract?
1. Definition of Standard
 2. Incentive Gap (earnings over standard)
 3. Time study grievance procedure
 4. Other _____

 5. I don't know.
31. If the head of a department, to whom do you report or to whom does your head report?
1. Vice president in charge of Manufacturing
 2. General Manager
 3. Comptroller
 4. Superintendent
 5. Plant Manager
 6. Other _____
32. If you are, or were to be, head of a department, to whom do you think you should report?
1. Vice President in charge of Manufacturing
 2. General Manager
 3. Comptroller
 4. Superintendent
 5. Plant Manager
 6. Other _____
33. Do you consider the position you hold carries with it enough authority to put into operation the plans and ideas you have?
1. Yes
 2. No
34. If you are not satisfied with the position you now hold, what position do you think would best suit your needs (with reference to better time studies)?

35. Were you hired directly into the time study department?
1. Yes
 2. No
36. If transferred to the time study department, what department were you in before the transfer occurred? _____
37. Are you satisfied with the salary you receive?
1. Yes
 2. No
38. What is the extent of your education?
1. Grammar School
 2. High School
 3. Trade School
 4. Business School
 5. College (list all degrees) _____

39. If a graduate engineer, do you hold an "Engineer-In Training" certificate?
1. Yes
2. No
40. If a graduate engineer, do you hold a Professional Engineer's License?
1. Yes
2. No
41. What is the minimum amount of education you believe necessary for time study work?
1. Grammar School
2. High School
3. College
42. Do you consider a college education _____ for time study work?
1. essential
2. desirable
3. unnecessary
43. If you are of the opinion that a college education is essential or desirable, how many years would you recommend? _____ years.
44. What type of college education do you consider best suited to time study work?
1. Engineering
2. Business
3. Science
4. Other _____
45. Do you consider shop experience _____ for time study work?
1. Essential
2. Desirable
3. Unnecessary
46. If you consider shop experience to be essential or desirable, how much experience would you recommend? _____ years
47. Is there an Industrial Engineering Department in your plant?
1. Yes
2. No
48. Is there a separate Time Study Department in your plant?
1. Yes
2. No
49. Total number of men on staff actively engaged in time study work. _____ men
50. Number of engineers on staff actively engaged in time study work.
_____ engineers
51. Number of union men on staff actively engaged in time study work. _____ men
52. Considering the number of employees in your plant, how many men do you believe should be on the time study staff? _____ men

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53. Do you believe that you have the cooperation of top management in doing your work?
1. Yes
 2. No
54. Do you believe your time study department to be sufficiently staffed with competent and well qualified personnel to do the job expected of it?
1. Yes
 2. No
55. Do the employees in your plant have a good understanding of time study principles?
1. Yes
 2. No
56. Is the educational program in your plant to give employees a better understanding of time study
1. adequate?
 2. inadequate?
 3. no program in effect.
57. Are the educational programs in your plant dealing with time study for the employees given on
1. company time?
 2. employees' time?
 3. a combination of both?
 4. none given
58. In general, are the employees in favor of time study?
1. Yes
 2. No
59. Do the employees cooperate with the time study staff?
1. Yes
 2. No
60. Do you believe that the foremen and supervisors in your plant are adequately educated in a proper understanding of modern time study practices?
1. Yes
 2. No
61. The educational program for foremen and supervisors on time study practices in your company is
1. adequate
 2. inadequate
 3. no program in effect.
62. Are the educational programs dealing with time study for foremen and supervisors given on
1. company time?
 2. employees' time?
 3. a combination of both?
63. Do you believe that a company should have a training program for its time study personnel?
1. Yes
 2. No

64. Does your company have a training program for its time study personnel that is
1. adequate
 2. inadequate
 3. no program in effect.
65. Are the training programs for time study men given on
1. company time?
 2. employees' time?
 3. a combination of both?
 4. none given
66. Is the training program for the union time study men the same as that for the company's men?
1. Yes
 2. No
 3. none for union men
67. If the answer to question (66) is no, is the training program for the union men
1. adequate?
 2. inadequate?
68. Is the training program for the union time study men given by
1. the union only?
 2. the company only?
 3. both the union and the company?
 4. an outside agency?
 5. none given
69. Does your company have any specific injunction against the use of motion pictures for methods study?
1. Yes
 2. No
70. Does your company have any specific injunction against the use of motion pictures for time study?
1. Yes
 2. No

FIGURE 5
CALIBRATION CHART

Bench mark value for each image of the Multi-Image rating loop

Images and their corresponding bench mark value are arranged in the Multi-Image loop as follows:

IMAGE NO.	BENCH MARK VALUE.	
1	2	3
155.8	143.8	137.6
4	5	6
132.4	122.8	118.5
7	8	9
105.3	98.7	95.3
10	11	12
93.0	81.6	79.2

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Group evaluation of the
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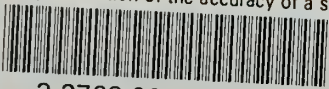
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